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TATA STEEL
#WeAlsoMakeTomorrow

TATA

GRP PIPES

Environment Friendly Solutions
for water and sewerage systems

NEW MATERIALS BUSINESS
An Initiative of **Tata Steel**

The earth, the air, the land, and the water are not an inheritance from our forefathers but on loan from our children. So we have to handover to them at least as it was handed over to us.

Mahatma Gandhi

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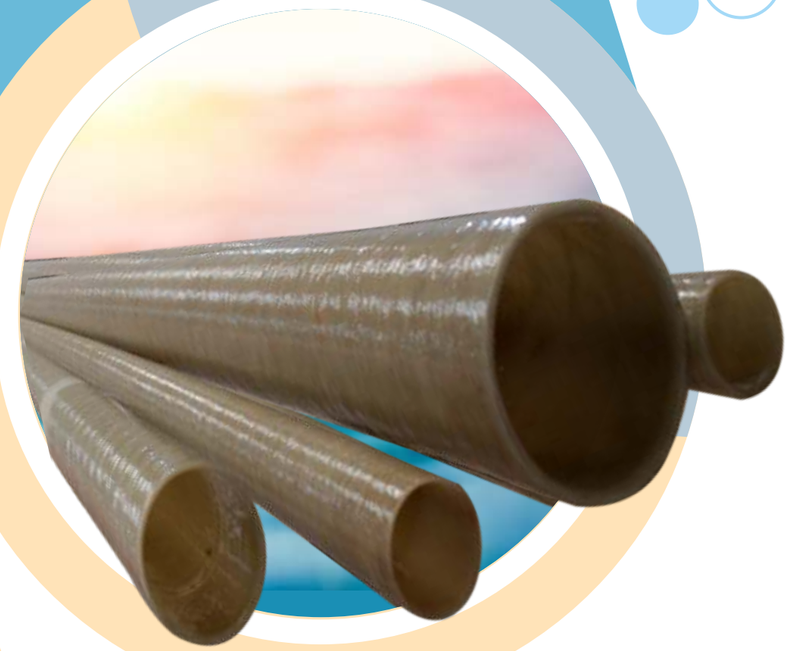


Fibre Reinforced Polymers:

Tomorrow's Solutions Today

Tata Steel Limited, one of the leading steel manufacturers, has ventured into GRP piping systems to bring in best-in-class quality pipes for catering to the unmet needs of the industry. Our goal is to solve the world's water and sewerage challenges with a sustainable solution. We aspire to be the most trusted partner for effectively conveying water for irrigation, storm and waste water, drinking water and industry requirements.

In recent times, the world has realised the need to move to a pollution-limiting, environment friendly and future-looking business scenario. Those in the steel domain, appreciate that better than most. Hence the buzz word in today's R&D lexicon is "Fibre Reinforced Polymer (FRP) Products".

Use of fibre reinforced polymer (FRP) composites for construction of new structures and rehabilitation of existing structures has increased significantly over the past decade. We see a rapid transition from conventional building blocks to advanced composites.

Tomorrow's applications demand material that is lightweight, durable, easy to maintain, offering high strength with design flexibility and having multiple functionalities.

Composites are the material of choice for infrastructure, automotive components, aerospace, construction, defence, marine and the health & wellness industries; phasing out conventional alternatives.

The new pipeline to the world

Why FRP?

Over the years, the global Glass Fibre Reinforced Plastic pipes market has become the best alternative for large diameter pipes whose application is witnessing rapid growth in diversified Industries such as irrigation, potable water, storm and sewage water, Industries, Water/ Waste Water and Oil and Gas.

The major drivers stimulating growth in the fibreglass pipes market are:

- Growing infrastructure development
- Increasing demand in irrigation projects to arrest evaporation losses and pilferage of water
- Increasing demand for fiberglass pipes in sewage and water management applications.
- Increasing production & exploration of oil & gas

GRP has evolved into the material of choice in construction in various industries because of the increasing demand for lightweight, high strength, corrosion resistance and durability.

Advantages of GRP Pipe Materials:

Sustainable solutions for the worlds of today and tomorrow

The ever-increasing demand for large diameter pipes in infrastructure and in industry has created a need for alternate materials for pipes materials and hence GRP pipes have found their way in to the existing markets.

Tata Steel Ltd, with their interest in the GRP pipe segment has put in continuous efforts in manufacturing and developing improved technology so that it can sustainably solve the problems and challenges in the areas of carrying drinking, irrigation and sewage water.

Superior Material Properties

Glass fibre reinforced plastic is a composite material, consisting of **a polymer resin, reinforcing glass fibres, and fillers**. The most common polymers are thermosetting polyester, vinyl ester, and epoxy resins. When cured, the resin defines the shape of the GRP component, and makes it resistant to chemical and environmental loads. There are several types of fibreglass available, the most common being E and E-CR (Electric/Chemical/Resistant) glass, with tensile strengths many times higher than steel. The most common filler is fine silica sand.

The glass fibre predominantly provides high strength and stability while the fillers provide high bending stiffness.

Glass fibres are placed along different directions to have strength along those directions while the resins hold the materials together and form a strong laminate which is durable, water proof and chemical corrosion resistant.

It also has strong thermal stability and resistance to UV radiation.

Safe & Environment friendly

The minimum service life of GRP pipes is 50 years which scores over other plastic materials and hence requires lesser disposal and is better for our environment. GRP pipes have lesser carbon footprint during manufacturing, transportation and installation of the same. It also imparts lesser amount of contamination with the liquid that it transports to the external environment due to its excellent leak-proof features. This helps preserve the ground water from contamination, preventing - health hazards and environmental pollution, and a loss in efficiency due to higher pumping requirements.

GRP pipes can be shredded and used in road construction, in cement manufacturing, or as an alternative to fossil fuel in furnaces.

Strong Economic Value

Due to its longer maintenance-free life and superior interior finish, GRP pipes have the capacity to manage the higher productivity in conveying a liquid over its service life without any extra cost, thus making it more economical over other pipe materials. The smooth inner surface (C Value of 150) helps in reducing the pipe size by one diameter and thus reducing pumping costs.

Adding up to greater value

Features	Attributes	Benefits
High Strength to Weight	Low transportation cost	Savings of 1/4th of a DI pipe and 1/10th of a concrete pipe
Light weight	Lower installation cost	Lightweight properties are important when considering the cost and ease of installation of pipes.
Corrosion Resistant	Reduces friction for the flowing liquid	• Saving energy required to pump • Long effective service life • No need for expensive cathodic protection • No need for pipe coating, wrapping, lining, painting or other additional applications. • Hydraulic characteristics effectively remains unchanged over time • Low maintenance cost
Long Service Life	Effectively survives harsh internal and external conditions. UV protection	• Lower maintenance and hence prevents frequent replacement. Savings due to lesser downtimes/shutdown
Smooth flow	Higher C value of 150	• Energy efficient transmission of liquids
Wide Applications	All varieties of joints, tees etc available. Effective for both overground and underground applications	• Easy material selection for all applications

Spectrum of Applications

Effluent and Sewage Water Discharge

Our GRP pipes are customised and structured to handle highly corrosive liquids and are effective for transporting municipal waste and storm water. The pipes are designed to handle extra loads caused by urban conditions. The smooth inner surface of the pipes also helps low gradient flow of sewers effectively without the requirement of frequent maintenance. A large and innovative range of fittings help easy installation of the sewer pipe network in the congested municipal areas.

Distribution of Raw Water and Potable Water

GRP pipes are perfectly suited for potable water distribution and transmission.

The pipes are supplied with a time tested jointing mechanism which ensures neither leakage of valuable water nor contamination of water through external medial.

Due to the light weight of the pipes they can be easily transported and installed in the busy areas of the city. They also come with customised fittings to take care of the laying site conditions.

Irrigation

Irrigation systems are the largest fresh water transportation systems which boost the agriculture of a country and hence it needs a long- term, reliable and robust pipe network to avoid loss of valuable water resources. The conventional open canal irrigation system has been responsible for huge water losses due to evaporation and pilferage and hence GRP pipes have proved to be an effective long-term solution across the world. The long service life of 50 years also helps avoid frequent rehabilitation of the pipe network and hence effectively justifies the additional capital expenditure of the government. The pipes can be laid overground as well as underground depending on the site conditions.

Industrial Applications

GRP pipes have wide-spread applications in industrial segments to effectively withstand the extremely harsh conditions. The pipe materials are resistant to chemical and mechanical corrosion and can withstand high thermal stresses arising out of the transported liquid. GRP pipes are prescribed for cooling water systems for power plants and desalination plants. They are also widely used for sea and raw water intake pipes for plants. Chemical and fertilizer plants typically use GRP pipes for effective transportation of corrosive and harsh liquids.

Advanced Technology

Tata GRP pipes are manufactured through the state-of-the-art filament winding process. The product ranges from 80 mm to 3000 mm dia. pipes.

Main raw materials used are superior quality glass fibre and polyester resin. Silica sand, surface mats, catalysts, additives and accelerators are other ingredients which are used in different proportions in manufacturing of the pipes.

The glass roving is wound in the hoop direction to build strenght around the circumferential direction while the chopped mats provide strength across the longitudinal direction. The structural layer consists of flass reinforced skins which sandwich the silica and glass - resin core to provide optimal bending stiffness. Polyester, Bisphenol, vinyl ester and epoxy resins are used as matrices depending on the pipe characteristics and the nature of the transported liquids.

World class quality & testing

Raw Material Quality

All raw materials are carefully selected based on vendor certification and compliance with our quality standards. These raw materials are then tested as samples prior to their use. These tests ensure that pipe materials comply with specifications as mentioned in the design.

Finished goods Quality

All finished goods are subjected to the following tests under the supervision of our quality experts:

- Visual Inspection
- Physical measurement of thickness, length, width and diameter
- Barcol Hardness
- Hydrostatic Leak tightness test (2 times the Nominal Pressure)

The following tests are conducted on sample basis:

- Composite structural analysis and design verification
- Pipe Stiffness
- Under deflection load following controls are checked – structural failure and inner surface
- Hoop tensile strength
- Axial tensile strength

Long Term Performance

GRP pipes apart from their short term quality criteria also need to be checked for long term performance criteria. The most important factors affecting long term performance of our GRP pipes which are considered are as follows

- Hydrostatic Design Basis (HDB)
- Long term Specific Ring Stiffness
- Long term Bending Strain
- Long term Strain Corrosion

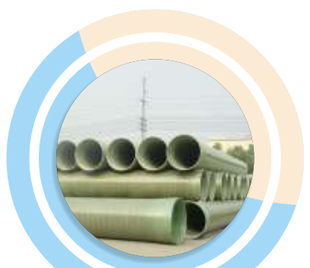
Other Quality Checks

The following criteria are also checked for all our pipes before doing the final certification

- Fire Resistance
- Ultra-Violet Resistance
- Abrasion Resistance
- Flow Velocity
- Resistance to different operating temperatures

Technical Data for Tata Steel GRP Pipes

Construction Material	Glass fibre, Resin and other additives
Operating Temperature	-50 deg C to + 70 deg C
Standard Lengths	from 6m to 12 m
Diameter Range	PN 3, 6, 9, 12, 16, 20, 25 and 32
Stiffness Classes	2500, 5000 and 10000 N/m
Estimated Life	50 years
Corrosion Protection	Not required
Standards Followed - International Pipe Standards	AWWA M 45, ASTM D3262, ASTM D 3754, ASTM D3517, AWWA C950, IS12709, IS14402



Reference Standards

AWWA M-45:

Fiberglass Pipe Design Manual for Underground and Aboveground Installation

AWWA C 950:

Fiberglass Pressure Pipe

ASTM D 3262

Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Sewer Pipe. Applicable for pipes 200 mm through 3600 mm diameter, with or without siliceous sand, and polyester or epoxy resin.

ASTM D 3517

Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pressure Pipe. Applicable for pipes 200mm through 3,600 mm diameter, with or without siliceous sand, and polyester or epoxy resin.

ASTM D 3754

Standard Specification for "Fiberglass", (Glass-Fiber Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe. Applicable for 200 mm through 3,600 mm diameter, with or without siliceous sand, and polyester or epoxy resin.

IS12709

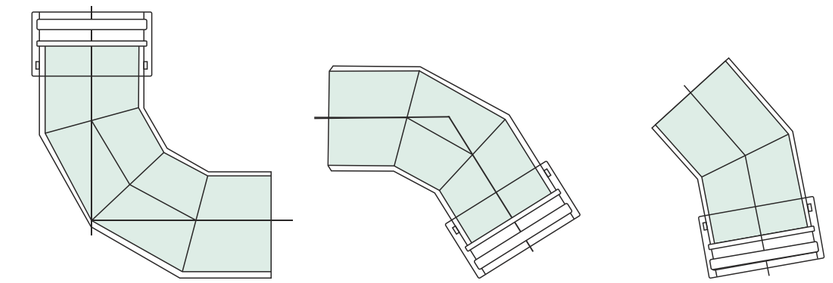
GRP pipes joints and fittings for use in potable water supply

IS14402

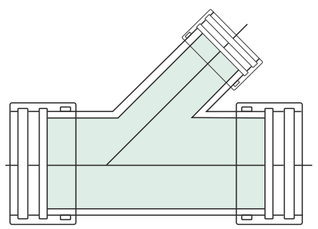
GRP pipes joints and fittings for use in transportation of sewerage, industrial waste and water (other than potable)

GRP Fittings

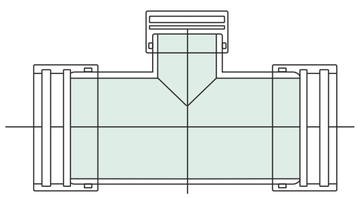
A standardised line of GRP fittings that are moulded or fabricated using the same materials that are used to produce GRP material can be supplied. One of the benefits of GRP pipes is the ability it provides to fabricate a wide assortment of fittings, standard as well as non-standard as per the requirements.



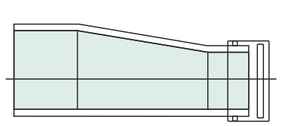
Elbows



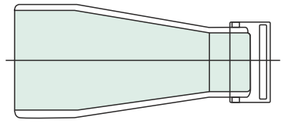
Wyes



Tees



Eccentric Reducers



Concentric Reducers

Jointing of GRP Pipes

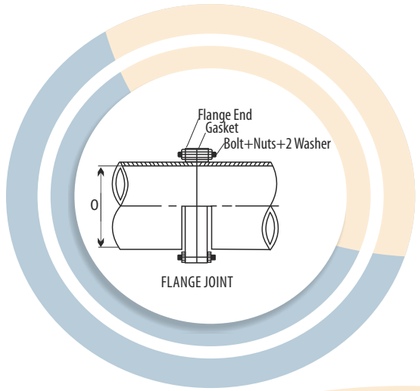
Jointing of GRP pipes can be broadly of two types. Restrained and unrestrained joints. For many years, thrust blocks have been successfully used in distribution systems for restraining pipelines all over the world. Thrust blocks, however, are not without limitations. There is an argument that thrust blocks are the cheapest form of pipeline restraints. When all of the costs such as pouring, labour, and forming time are added to the price of thrust blocks, joint restraint systems can be as effective and less costly. Thrust blocks are commonly used with push-on fittings. Once the line is restrained and buried, it not the line is ready for testing. This hastens the construction process and prevents the need for trenches to remain open for long periods of time. This is not possible with unrestrained joints that require thrust blocks. Some experts are of the opinion that thrust blocks can be eliminated using joint restraints.

Restrained Joints

Because of the restraining factor these joints are better equipped to handle both the hoop and longitudinal stresses. Some restrained joints are as follows:

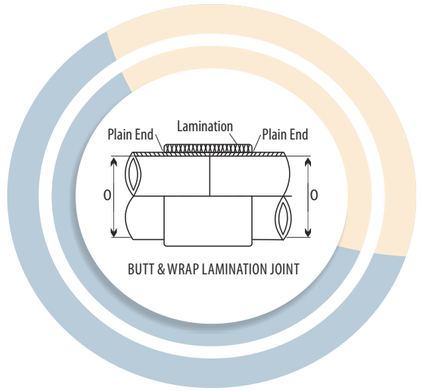
Flanged Joints

Flanged joints are suitable for medium and low-pressure pipelines and equipment fittings. In order to enable connections with metallic pipes and to allow for easy assembling and disassembling of process lines, flanges can be fixed with pipes fittings, drilled in accordance with ANSI, BS, DIN or other specifications.



Butt and Wrap Joint

In general, these joints will only be used for diameters over 300mm. The preparation of this rigid joint requires good craftsmanship. Butt and wrap is for all diameters starting even as low as 25 mm or 1 inch.

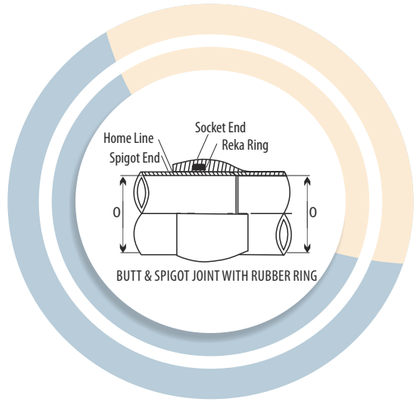


Un-restrained Joints

Such kind of joints can handle hoop stress and allow for axial movement

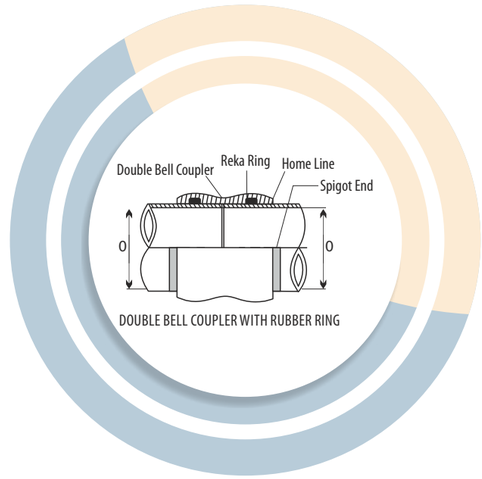
Bell and Spigot Joint

The socket end of this joint is an integral filament wound part of the pipe with a recurring sitting in a groove. The Spigot end is a machined part on which the O-ring seal is positioned. The flexible joint allows for axial movement of the spigot in the socket.



Double Bell Coupling Joint

Pipes are joined using double bell coupling. The sealing of the joint is achieved by the compression of two electrometric rubber gaskets when the joint is assembled. The gasket seals go more when the pressure inside the pipe goes up.



MECHANICAL & PHYSICAL PROPERTIES	
Property	**Unit**
Specific Gravity	1580 - 1800 kg/m3
Hoop Tensile Strength	220 - 490 N/mm2
Axial Tensile Strength	40 - 50 N/mm2
Co-efficient of Thermal Expansion	18 - 30 x 10^-6 (mm/mm/deg C)
Flexural Modulus	13,800 - 20,000 N/mm2
Stiffness	51500 - 15000 N/mm2
Barcol Hardness	Minimum 35
Hoop Modulus of Elasticity	20 - 30 KN/mm2
Axial Modulus of Elasticity	06 - 10 KN/mm2
Thermal Conductivity	0.2 - 0.35 W/mdeg C

Inspection of Pipes

All pipes should be inspected upon receipt at the job site to avoid transit damage if any. It is advisable to conduct further inspection of the pipe just prior to installation. Shipments should be inspected upon, as follows:

1. An overall inspection of the load is advisable before unloading. If the load is intact, ordinary inspection is sufficient to make sure the pipe has arrived without damage.
2. If the load has shifted or indicates rough treatment, carefully inspect each pipe section for damage. Generally, an exterior inspection will be sufficient to detect any damage.
3. If any imperfection or damage is found, immediately segregate the affected pipes and contact us.
4. Do not use a pipe that appears damaged or defective.

Spool Pipes

We also manufacture and supply GRP pipes & fittings in the form of spools for easy installation at site, as per site requirement. It reduces labour costs and fabrication time at sites.

GRP Pipe Repairing

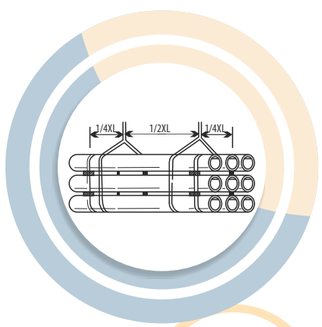
Normally, pipes with minor damage can be repaired quickly and easily at the job site by a qualified and trained repair specialist. Repair designs can vary greatly due to pipe thickness, wall composition, application, type and extent of damage. Therefore, it is suggested to take proper advice from the manufacturer before repairing. Pipes not repaired properly may not function as desired.

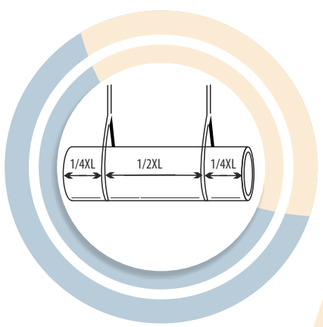
Unloading and Handling Pipes

The responsibility of unloading the pipes is the responsibility of the customer. It's important to exercise caution during unloading. Guide ropes attached to pipes or packages will enable easy manual control when lifting and handling. Spreader bars may be used when multiple support locations are necessary. Ensure there is no drop, impact, or bump of the pipe, particularly at ends. Pipe packages may be handled using a pair of slings as shown

Single Pipes

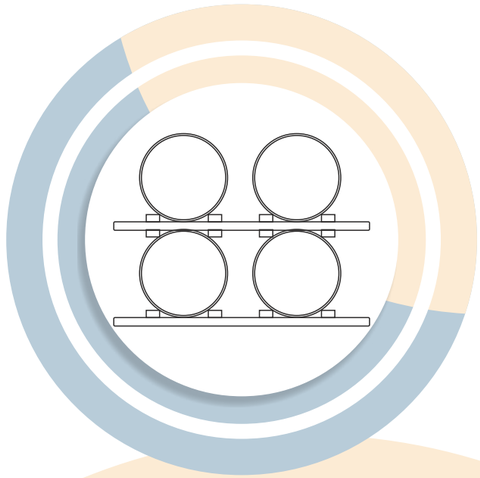
Single pipes must be unloaded and handled separately and with care. It is advisable to use pliable straps, slings or ropes to lift single pipes. Practices such as using steel cables or chains to lift or transport the pipe are not recommended. Pipe sections can be lifted with only one support point, although two support points placed as mentioned in figure below make the pipe easier to control.





Stacking

GRP pipes should be stored on flat timber supports at a maximum of 6 meteres spacing and 3 meteres spacing for small diameter pipes with chocks (Figure below). Such stacking also helps placing and removal of lifting slings around the pipe. The stacking should be done in such a way so that it is stable against any high winds, lateral push or load etc. Stacking of pipes with diameters larger than 1400 mm is generally not recommended.



Transportation of Pipes

During transportation of GRP pipes, support all pipe sections on flat timber. The spacing between supports can be a maximum of 4 meteres and 3 meteres for small diameter pipes with 2 meteres maximum overhang. Chock the pipes to maintain stability (Figure below). Strap the pipe to the vehicle over the support points using pliable straps or rope –never use steel cables or chains without adequate padding to protect the pipe from abrasion.

We advise to nest various pipe diameters during transportation. It is advisable to (a) Use pliable ropes for lifting nested pipes (b) Not stack the nested pipes at the site.

De-nesting of pipes should be done carefully a pre-allocated station. the inside pipe may be removed by lifting it slightly with an inserted padded boom to suspend the section & carefully move it out without damaging the outer pipe.